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Utilization of Laboratory Facilities and Student Academic Performance in Chemistry

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ABSTRACT

The study investigated the utilization of laboratory facilities and students' academic performance in chemistry. A total of 230 respondents (30 teachers and 200 SSII students) in Obio/Akpor Local Government Area were drawn through simple random sampling technique from four public secondary schools formed the sampled size for the study out of a target population 3,693 students and 42 chemistry teachers. Three research questions guided the study. Two hypotheses were formulated and tested at 0.05 alpha level using two instruments which were utilization of laboratory facilities questionnaire (ULFQ) and a proforma for collating students' promotion examination score for chemistry. The data collected were analyzed using mean, standard deviation and Pearson product moment correlation as statistical tools. The results revealed that laboratory facilities are not adequately utilized in secondary schools for teaching chemistry as viewed by teachers and students. Also there was a significant relationship between utilization of laboratory facilities and students' academic performance in chemistry. Based on the findings, it was recommended that adequate laboratory facilities be provided by relevant authorities. The utilization of laboratory facilities by teachers should be encouraged by the school authorities.

Introduction

The important of Chemistry as a natural science in our modern world is overwhelming and without doubt an agent of transformation. As a science subject it had brought about socio-economic development and technological advancement of most nations through the increase integration and a product of science.

Chemistry is empirical in mature and involves chemical phenomena that required investigations, observations and recording of reactions using reagent and equipment. As a natural science chemistry requires understanding, development and application for it to be meaningful. Instructional science laboratory are widely regarded as a key component of science instruction because most science are activity- based exploration into the natural world. (American Association of Advancement of Science 2006).

A laboratory can be refers to as a scientist workshop or as a building or room in which a scientist works, with apparatus for examination and testing of materials (Abimbola 2001). The laboratory is an instructional facility used by the science teachers to help the students learn about science and how the scientists investigate the world around them (Nbina 2013).It can also be seen as a place equip for experimental study. The apparatus, equipment and chemical the scientist works with in the laboratory are the facilities.

Airvonen and Viiri (2002) have reported that as a result of learning practical skills and scientific learning methods, students experience an increase in motivation and teachers gain the opportunity to evaluate the knowledge of their students. Some common goals of laboratory are to allow students to demonstrate for themselves important phenomenon from the discipline being studied.

It enhances mastery of subjects matter and developed scientific reasoning. It aids the advancement of practical skills; inculcate the development of teamwork abilities in students to collaborate effectively with others in carrying out complex task. Examples of such facilities include preparatory table, periodical charts, Test tube beakers, pipettes etc. the laboratory is the centre of scientific studies as long as science remain both product and process.

Chemistry as a practical subject is beneficial to students because it makes each lesson content more comprehensive, minimizes forgetting, leads to knowledge transfer, help learners acquire favorable attitude towards a particular subject and learning in general. Ahme (2007) Encouraged learners to discover for themselves through spontaneous interaction with concrete objects in the environment. Chemistry requires practical's to facilitate conceptual understanding, active engagement of students ideas and baseline knowledge of science. The adequate utilization of laboratory facilities foster both brains on and hand-on effect in the practical class. Pwal (2000) opined that chemistry is experimental in nature and that utilization of laboratory facilities help students enhance their scientific understanding through observing, classifying counting, measuring and interacting with objects and events of scientific interests which in turn influence achievement of the students.

Mayer (2004) observed that the utilization of functional laboratory facilities promote students participation, during laboratory activities which in turn enable them identify problems, pose relevant questions, perform efficient and effective experiments, make judgment on alternative hypotheses and interpretation of data student therefore, learn to discover, learn from discovery and learn by discovery.

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Teachers are guardian of knowledge and practical knowledge cannot be properly acquired without adequate utilization of laboratory facilities provided by the school for teacher's use to improve learner's performance. Effective utilization of laboratory facilities provides stimulus on interest and motivation on the part of student provided for the teacher has knowledge of their utilization.

Effective utilization of laboratory facilities offer the chemistry teacher the advantage of an immense variety of methods and techniques with which he could present information, principles and skills. Onwioduokit (2013) assert that the improper integration of class room science concepts (theory) and practical has propelled irregular dichotomy in science learning and deficiencies in scientific practical skills.

The scientific values of practical work in most secondary school is questionable because most secondary schools science practical's are usually performed close to the certificate examination of the SS I11 students which lead to problem.

Statement of Problem

The West African Examination Council (WACE) Chief Examiners Report (2002-2006) has shown consistent poor performance of students in chemistry. Also the Chief examiner's report (2009) show that despite the improvement in the subject, students' performance in chemistry is poor due to inadequate utilization of laboratory facilities to practical work and nor- acquisition of relevant skills in carrying out related laboratory activities by both students and teachers.

However, to buttress the above argument a situational report on students' performance in West African Examination Council (WAEC) is highlighted.

Table 1. Performance (2000-2012) of Students in SSCE Chemistry.

Year	Total Number of Students	% Credit Grade	% Pass Grade	% Fail Grade
2000	182 659	21.39	22.25	52.28
2001	195 810	31.88	26.71	14.39
2002	301 740	36.25	27.06	36.67
2003	1140 197	40.82	22.91	20.93
2004	1035 671	40.37	25.31	33.36
2005	1066 890	50. 65	18.63	27.29
2006	1159 830	45.11	22.84	30.29
2007	1254481	46.16	24.86	26.51
2008	1340 907	43.46	26.50	25.57
2009	1425237	56.35	25.55	18.28
2010	1398321 '	38.67	30.15	31.12
2011	1533140	43.58	23.89	32.45
2012	1612532	40.82	21.78	37.45

Source: WAEC (2012)

The figures in the table showed that between (2000-2012) students' performance have relatively been poor in recent times with exception of 2009 when the credit level performance in chemistry rises to 56.35%. If this poor performance trend continues then the educational system is in jeopardy and the much needed scientific and technological development will be a mirage.

Hence the need for this study is to find ways of enhancing students' performance through adequate utilization of laboratory facilities.

Aim and Objectives of the Study

The aim of this study was to determine the level of utilization of laboratory facilities by chemistry teachers and students as well as its relationship with student's scores and their academic performance in chemistry.

Specifically the objectives of the study were as follows.

1.To determine the extent to which individual items of laboratory facilities are utilized as viewed by chemistry teachers.

2.To determine the extent to which individual items of laboratory facilities are utilized as viewed by chemistry students.

3.To ascertain the relationship between utilization of laboratory facilities and students' academic performance in chemistry.

Research Questions

The following research questions guided the study

1.To what extent is each individual items of laboratory facilities are utilized as viewed by chemistry teachers?

2.To what extent is each individual items of laboratory facilities are utilized as viewed by chemistry students?

3.What is the difference in view between students and teachers on the utilization of laboratory facilities?

4.What is the relationship between utilization of laboratory facilities and students' academic performance in chemistry?

In addition, two null hypotheses were formulated as tentative answers to the research question three and four which were tested at 0.05 level of significance.

Ho_1:There is no significant difference between students and teachers view of the utilization of laboratory facilities.

Ho_2:There is no significant relationship between utilization of laboratory facilities and students' academic performance in chemistry.

Research Method

A descriptive survey and correlation design was adopted for this study. All the SSII chemistry students of about 3,693 and about 42 chemistry teachers of the fourteen (14) public secondary schools in Obio-Akpor Local Government Area (LGA) of Rivers State formed the population (source Department of planning and research of Rivers State senor secondary schools Board 2016).

Sample size of the study was 30 chemistry teachers and 200 chemistry students from SSII drawn through simple random sampling from the 4 public senior secondary schools. Summarily sampled respondents for the study were 230 responds.

Instrumentation

The instrument for data collection was tagged Utilization of Laboratory Facilities Questionnaire (ULFQ) developed by the researcher (ULFQ) was used to determine the utilization of laboratory facilities as viewed by both teachers and students.

Proforma was used to collate the student promotional examination scores for chemistry in 2015/2016 academic year which served as student's academic performance in chemistry.The questionnaires instrument was scored as Always (AL) with 5-points Very often (VO) with 4-points, sometimes (ST) with 3-points, Rarely (RY) with 2-points and Never (NR) with 1-point.The ULFQ consist of 50 items in all.

Validity/Reliability of Instrument

The instrument was validated by lecturers in Ignatius Ajuru University of Education one in Measurement and Evaluation and the other from the Department of Chemistry. The reliability of the utilization of laboratory facilities questionnaires was determined by administering the instrument to 10 teachers and 30 students from Port Harcourt Local Government Area (LGA) of Rivers State.

The reliability coefficient was determined using Pearson product moment correlation statistic and correlation coefficient index (r) obtained was 0.76 for the instrument.

The reliability of the proforma was not determined since it is merely used to collate already existing. That is promotion examination scores in chemistry of the students for the 2015/2016 academic year.

Method of Data Collection

Copies of the instrument (ULFQ) were administered directly to the respondents by the researcher with the help of research assistants domiciled in the school. Instructions guiding the filling of the instruments were given to the respondents especially the students about the filling of the questionnaire, the instruments were retrieved immediately. On the other hand, the Proforma was used by the researcher to collate the promotion examination scores in chemistry of the students in each of the schools from records of examination scores in the principal's office.

Data Analysis

Data were analyzed using descriptive statistics of mean, standard deviation while inferential statistics of t-test and Pearson product moment correlation statistic was used to test the hypotheses. Also, a mean of 3.00 was considered as the criterion mean that is any item having a mean value of 3.00 and above was considered to be frequently used while items with mean value below 3.00 were considered not to be used frequently. SPSS (statistical package for the social science) was used.

Research Question 1: To determine the extent to which individual items of laboratory facilities are utilized as viewed by chemistry teachers

Table 2; showed that 13 (26%) out of 50(100%) laboratory facilities were accepted in terms of utilization while 31(62%) out of 50(100%) laboratory facilities were rejected in terms of frequency of utilization. Base on the percentage of utilization of laboratory facilities usage it depicts that chemistry teachers do not adequately utilized laboratory facilities for the teaching and learning of chemistry. Laboratory facilities such as test-tube, wash bottles, pH-metre, red limus, NaCl, NaOH, potassium permanganate, beakers pipettes etc. were accepted by the teachers to have been utilized for chemistry teaching and learning. This implies that majority of the laboratory facilities were not frequently used by teachers during laboratory experiments in the schools.

Research Question 2: To determine the extent to which individual items of laboratory facilities are utilized as viewed by chemistry students.

Table 2. Means value for the utilization of individual items of laboratory facilities by chemistry Teachers.

SN	Items	Number	Means	Standard Deviation	Criterion Means	Decision
1	Chemistry laboratory	200	1.98	.140	3.00	Rejected
2	Preparatory table	200	2.98	.140	3.00	Rejected
3	Electricity supply	200	2.00	.142	3.00	Rejected
4	Water supply	200	2.98	140	3.00	Rejected
5	Periodical charts	200	2.98	.140	3.00	Rejected
6	Tripod stands	200	2.99	100	3.00	Rejected
7	Retort stands	200	2.99	122	3.00	Rejected
8	Test tubes	200	3.98	.140	3.00	Accepted
9	Beakers	200	3.98	.140	3.00	Accepted
10	Pipettes	200	3.99	.100	3.00	Accepted
11	Measuring cylinders	200	3.98	.140	3.00	Accepted
s12	Weighing balance	200	2.99	.100	3.00	Rejected
13	$AgNO_3$	200	1.99	.100	3.00	Rejected
14	$Ca(OH)_2$	200	299	122	3.00	Rejected
15	Computers	200	1.99	.100	3.00	Rejected
16	Overhead projectors	200	2.99	.100	3.00	Rejected
17	Thermometer	200	1.99	.100	3.00	Rejected
18	Bunsen burners	200	2.99	.100	3.00	Rejected
19	Test tube racks	200	2.99	.158	3.00	Rejected
20	Volumetric flask	200	2.99	.100	3.00	Rejected
21	Fume cupboard	200	1.99	-100	3.00	Rejected
22	Desiccators	200	1.99	.122	3.00	Rejected
23	Spatula	200	2.99	.100	3.00	Rejected
24	Burette	200	2.99	.100	3.00	Rejected
25	Bom calorimeters	200	1 99	.100	3.00	Rejected
26	Accumulator	200	1.99	.100	3.00	Rejected
27	Electrolytic cell	200	1.99	.100	3.00	Rejected
28	PH meter	200	3.99	.158	3.00	Accepted
29	Red litmus	200	3.99	.100	3.00	Accepted
30	Blue litmus	200	2.99	.100	3.00	Rejected
31	Evaporating discs	200	3.99	.158	3.00	Accepted
32	Condensers	200	1.99	.100	3.00	Rejected
33	Thermometers	200	1 99	.100	3.00	Rejected
34	Benzoic acid	200	1.99	100	3.00	Rejected
35	NaOH	200	3.99	.100	3.00	Accepted
36	NaCl	200	3.99	.100	3.00	Accepted
37	Na_2SO_4	200	2.99	.100	3.00	Rejected
38	NH_4 OH	200	1 99	.100	3.00	Rejected
39	Copper turnings	200	1.99	.100	3.00	Rejected
40	Ethyl alcohol	200	2.99	.100	3.00	Rejected
41	Potassium permanganate	200	3.99	.100	3.00	Accepted
42	Salicylic acid	200	2.99	.100	3.00	Rejected

43	Methyl orange indicator	200	2.99	.100	3.00	Rejected
44	Indicator bottle	200	1 98	.100	3.00	Rejected
45	Preparatory room	200	2.98	.140	3.00	Rejected
46	Laboratory tables	200	1.99	.122	3.00	Rejected
47	Wash bottle	200	3.98	.140	3.00	Accepted
48	Aqueous ammonia	200	3.99	.122	3.00	Accepted
49	Test tube holders	200	4.00	.071	3.00	Accepted
50	Ethanoic acid	200	2.9.9	.100	3.00	Rejected

Table 3. Means value for the utilization of individual items of laboratory facilities by chemistry students.

SN	Items	Number	Means	Standard Deviation	Criterion Means	Decision
1	Chemistry laboratory	30	2.76	.555	3.00	Rejected
2	Preparatory table	30	2.98	.141	3.00	Rejected
3	Electricity supply	30	2.98	.141	3.00	Rejected
4	Water supply	30	2.98	.141	3.00	Rejected
5	Periodical charts	30	1.98	.141	3.00	Rejected
6	Tripod stands	30	2.98	-141	3.00	Rejected
7	Retort stands	30	2.98	.141	3.00	Rejected
8	Test tubes	30	3.98	.141	3.00	Accepted
9	Beakers	30	3.98	.141	3.00	Accepted
10	Pipettes	30	3.98	.141	3.00	Accepted
11	Measuring cylinders	30	3.98	.141	3.00	Accepted
12	Weighing balance	30	3.98	.141	3.00	Accepted
13	$AgNO_3$	30	3.98	.141	3.00	Accepted
14	$Ca(OH)_2$	30	2.98	.141	3.00	Rejected
15	Computers	30	1.98	.141	3.00	Rejected
16	Overhead projectors	30	1.02	.141	3.00	Rejected
17	Thermometer	30	3.98	.141	3.00	Accepted
18	Bunsen burners	30	1.98	.141	3.00	Rejected
19	Test tube racks	30	1.02	.141	3.00	Rejected
20	Volumetric flask	30	1.98	.141	3.00	Rejected
21	Fume cupboard	30	1.98	.141	3.00	Rejected
022	Desiccators	30	3.02	.141	3.00	Accepted
23	Spatula	30	1.98	.141	3.00	Rejected
24	Burette	30	4.02	.141	3.00	Accepted
25	Bom calorimeters	30	1.02	.141	3.00	Rejected
26	Accumulator	30	1.02	.141	3.00	Rejected
27	Electrolytic cell	30	1.98	.141	3.00	Rejected
28	PH meter	30	1.02	.141	3.00	Rejected
29	Red litmus	30	2.98	.141	3.00	Accepted
30	Blue litmus	30	4.04	.198	3.00	Accepted
31	Evaporating discs	30	2.98	.141	3.00	Rejected
32	Condensers	30	1.02	.141	3.00	Rejected
33	Thermometers	30	1.98	.141	3.00	Rejected
34	Benzoic acid	30	1.02	.141	3.00	Rejected
35	NaOH	30	3.98	.141	3.00	Accepted
36	NaCl	30	3.98	.141	3.00	Accepted
37	Na_2SO_4	30	3.98	.141	3.00	Accepted
38	NH_4 OH	30	1.98	.141	3.00	Rejected
39	Copper turnings	30	1.02	.141	3.00	Rejected
40	Ethyl alcohol	30	2.98	.141	3.00	Rejected
41	Potassium permanganate	3	4.03	.141	3.00	Accepted
42	Salicylic acid	30	1.02	.141	3.00	Rejected
43	Methyl orange indicator	30	3.98	.141	3.00	Accepted
44	Indicator bottle	30	3.28	.141	3.00	Accepted
45	Preparatory room	30	2.98	.141	3.00	Rejected
46	Laboratory tables	30	1.98	.141	3.00	Rejected
47	Wash bottle	30	1.98	.141	3.00	Rejected
48	Aqueous ammonia	30	2.00	.000	3.00	Rejected
49	Test tube holders	30	3.00	.000	3.00	Accepted
50	Ethanoic acid	30	1.00	.000	3.00	Rejected

Table 3; showed that 19(38%) out of 50(100%). Laboratory facilities were accepted in terms of utilization while 31(62%) out of 50(100%) were rejected in terms of frequency utilization. laboratory facilities such as test tube holders, indicator bottles test tube beakers pipettes measuring cylinder, silver nitrate, thermometer etc. Based on the utilization of laboratory facilities usage it depict that students do not adequately utilize laboratory facilities for studying of chemistry. It implies that the utilization level of the laboratory facilities as viewed by chemistry students were below average.

Research question 3 and (Hypothesis 1) what is the difference in view between students and teachers on the utilization of laboratory facilities?

Table 4. t-test analysis of students and teachers view of utilization of laboratory facilities.

Group Statistics

	GROUPS	N	Mean	Std. Deviation	Std. Error Mean
SCORES	STUDENTS	200	144.39	.631	.045
	TEACHERS	30	114.47	.860	.157

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
SCORES	Equal variance assumed	6.993	.009	229.794	228	.000	29.918	.130	29.662	30.175
	Equal variance not assumed			183.206	33.844	.000	29.918	.163	29.586	30.250

Table 4 shows that the utilization of laboratory facilities mean scores of students is higher than the teachers which are 144.39 and 114.47 respectively. It also indicates that the standard deviation of students is.631 and teachers.860. The table shows the difference between the students' and teachers t-values to be 229.794 and 183.206 respectively. Their degree of freedom is 228. It also indicates that a significant difference exists between the students and teachers utilization of laboratory facilities since .000 is less than 0.05 level of significant. Thus hypothesis 1 is rejected at $p < 0.05$ level of significant.

Research question 4 and (Hypothesis 2) what is the relationship between utilization of laboratory facilities and students' academic performance in chemistry.

Table 5. Analysis of the relationship between utilization of laboratory facilities and students' academic performance in chemistry.

Descriptive Statistics

	Mean	**Std. Deviation**	**N**
STUDENTS ACADEMIC PERFORMANCE	64.97	13.166	200
UTILIZATION OF LABORATORY FACILITIES	135.39	40.296	200

Correlations

		STUDENTS ACADEMIC PERFORMANCE	UTILIZATION OF LABORATORY FACILITIES
STUDENTS ACADEMIC PERFORMANCE	Pearson Correlation	1	.783**
	Sig. (2-tailed)		.000
	N	200	200
UTILIZATION OF LABORATORY FACILITIES	Pearson Correlation	.783**	1
	Sig. (2-tailed)	.000	
	N	200	200

**. Correlation is significant at the 0.01 level (2-tailed).

The result in **table 5** indicates that the mean scores of students' academic performance is 64.97 while their utilization of facilities values are 135.39.It also shows that the standard deviation values of both are 13.166 and 40.296.

The students are 200 in numbers. The table shows that there is a significant relationship between students' performance and utilization of laboratory facilities at point .000 level of significant. Thus hypothesis 2 is rejected at $p < 0.05$ level of significant.

Discussion of Findings

The findings of the study in table 2 showed that majority of the laboratory facilities are not frequently used during laboratory experiments in the schools by the view of chemistry students. These findings are in agreement with Opara (2008) examined the utilization of laboratory facilities and students' academic performance in chemistry. The finding reveal that 26% of this laboratory facilities were utilized during chemistry teaching and learning while 62% showed that laboratory facilities were never utilized during chemistry teaching. The finding also revealed that laboratory facilities have a significant influence on the student academic performance in chemistry.

Results of findings in table 2 in respect to the utilization of laboratory facilities as viewed by chemistry teachers revealed that almost half of the laboratory facilities are not frequently utilized by chemistry teachers. It has been observed that most schools teach practical only when the student are about to write Practical external examination from either (WAGE or NECO) their final year of senior secondary school career. These findings do not agree with (Aladejana and Aderibigbe 2007) who opined that teachers who know how to make use the laboratory facilities and equipment to the advantage of the students carry them along as they arouse in the students the interest and desire to know and experience, and thus are able to get the desired learning outcomes.

Findings in table 3 showed a significant relationship between student's performance and utilization of laboratory facilities. It is in line with those of (Ciwar 2005).

The findings of the study in table 4 shows that t-values of students is higher than that of teachers and there is significant different in the utilization of laboratory facilities between the students and teachers.

Conclusion

In conclusion, the study revealed that the utilization of laboratory facilities in schools by both teachers and students is generally low. Furthermore, even though utilization of laboratory facilities and students' academic performance in chemistry is significant student should be introduce to practical work from the onset in order to strike a balance between their academic performance and the utilization of laboratory facilities during experimental studies in the school.

Recommendation

1. It is imperative that adequate laboratory facilities be provided by the relevant authorities.
2. The utilization of laboratory facilities by teachers should be encouraged by the school authorities.
3. As much as possible, chemistry concepts should be taught practically by chemistry teachers as laboratory facilities allowed students to interact and understand chemistry concepts.
4. Chemistry teachers should attend conferences and seminars for exposure, training in handing and using laboratory facilities that help to update their knowledge on scientific practical initiative.

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